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(54) **STERILIZATION TUNNEL**

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(57) **ABSTRACT**

A sterilization tunnel for pharmaceutical containers such as vials has an inlet zone, a sterilization zone, and a cooling zone. A conveyor belt for the vials is disposed inside the sterilization tunnel. An emptying device that can be raised and lowered is disposed in the vicinity of the cooling zone. In order to empty the sterilization tunnel, the frame-shaped emptying device is lowered onto the conveyor belt and then pushes an emptying slider, which is being moved through the sterilization tunnel together with the last vials disposed on the conveyor belt, out from the sterilization tunnel. The emptying device permits a particularly simple operation of the sterilization tunnel.

**4 Claims, 2 Drawing Sheets**

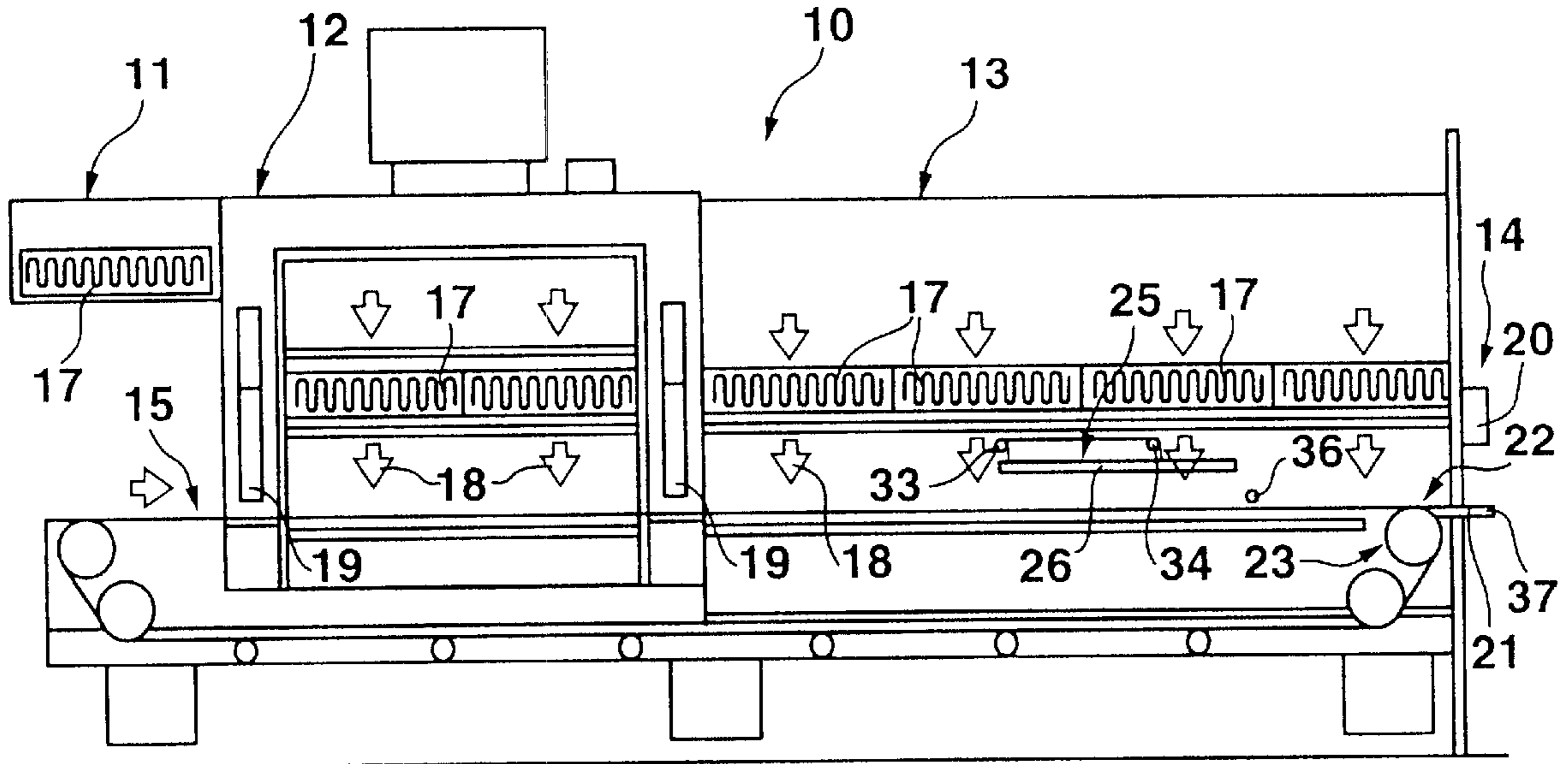


Fig. 1

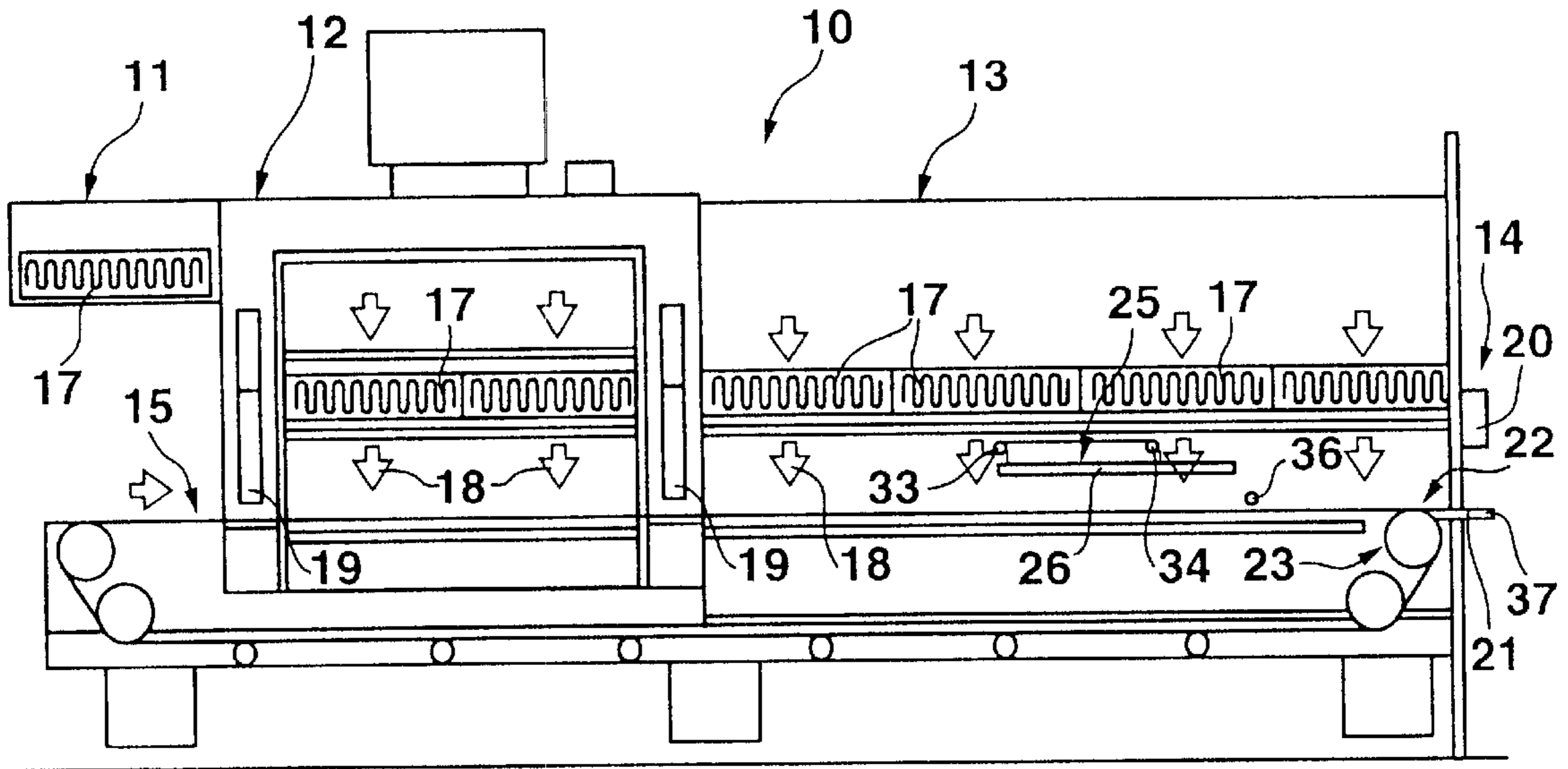


Fig. 2

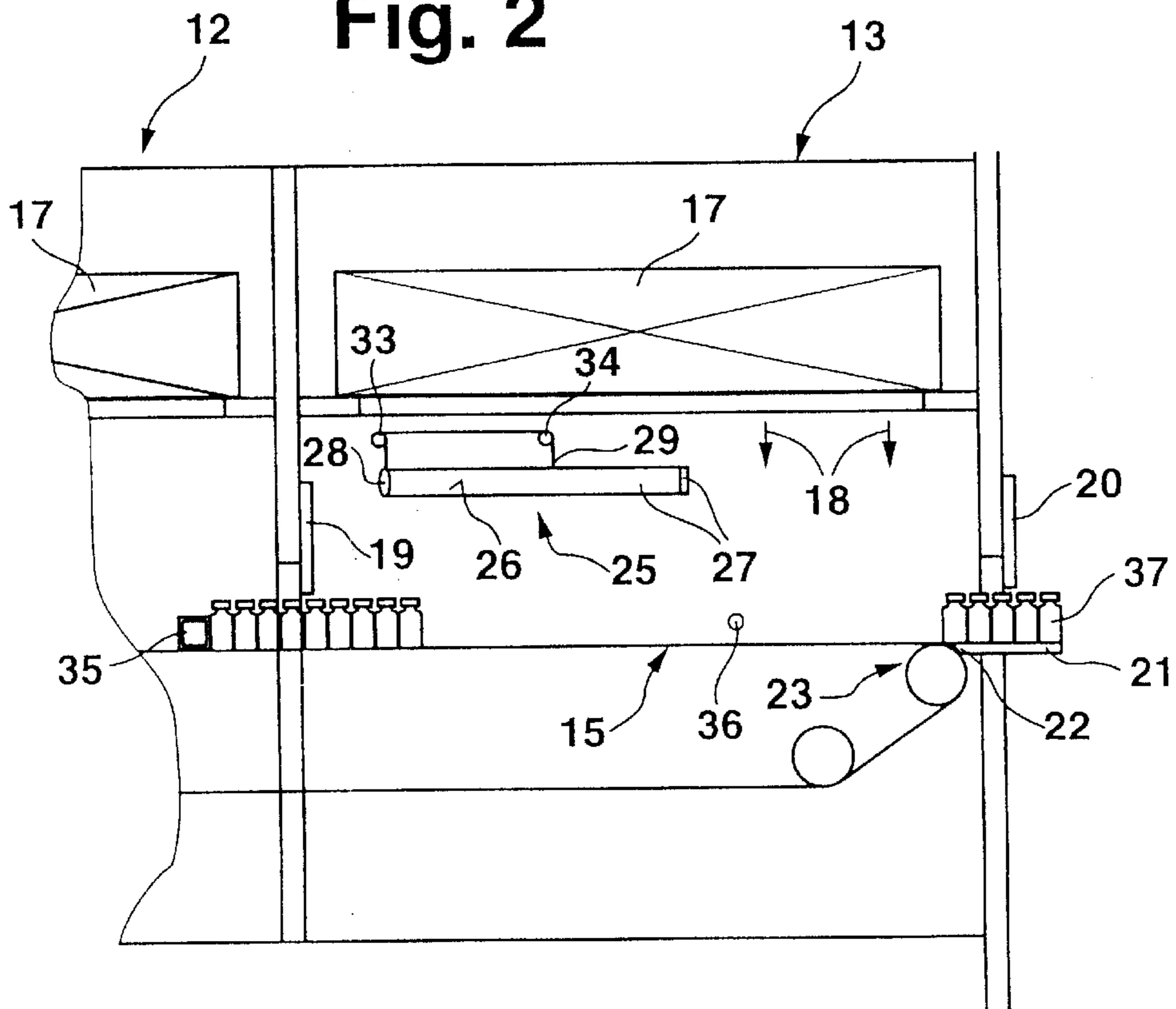


Fig. 3

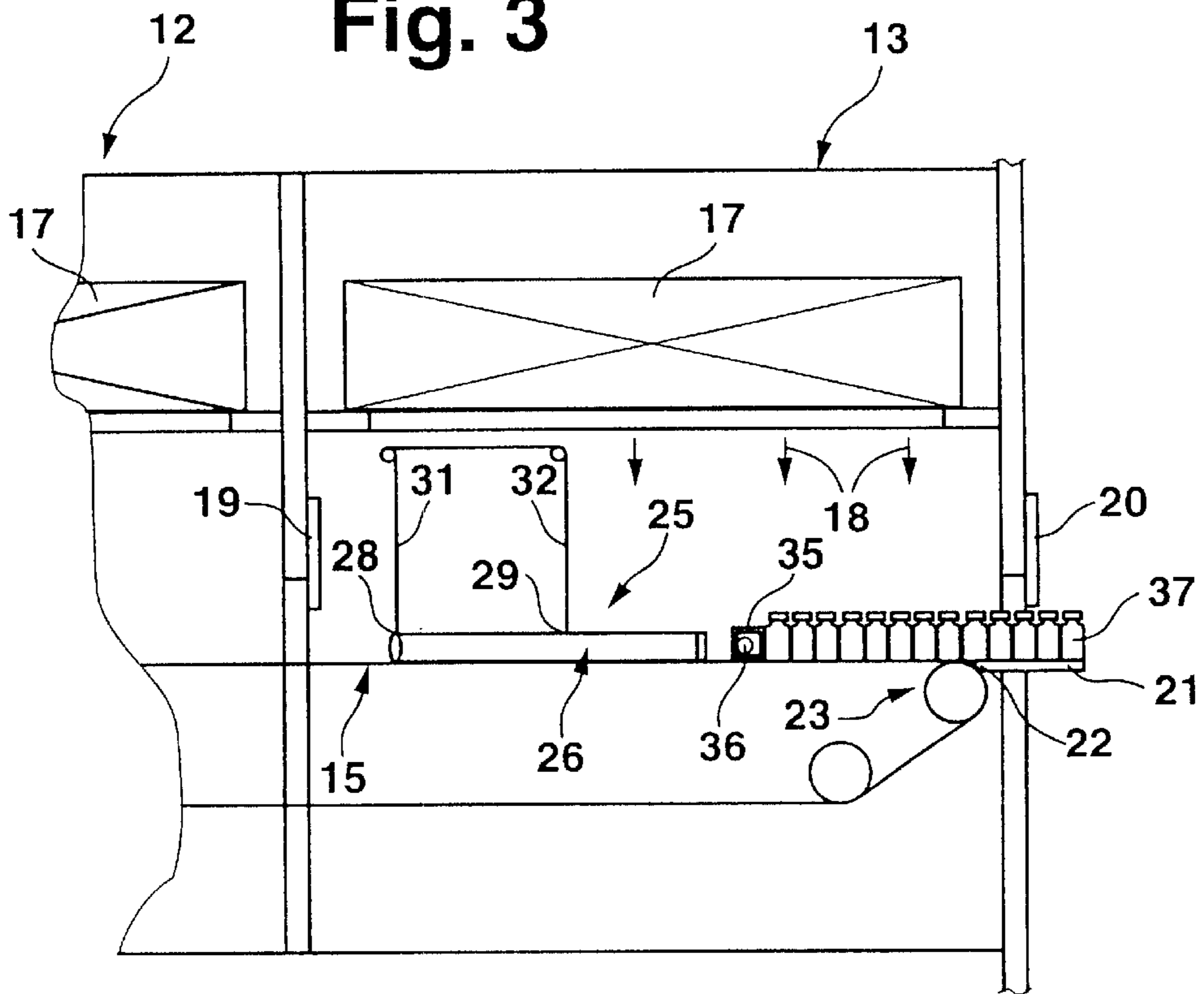
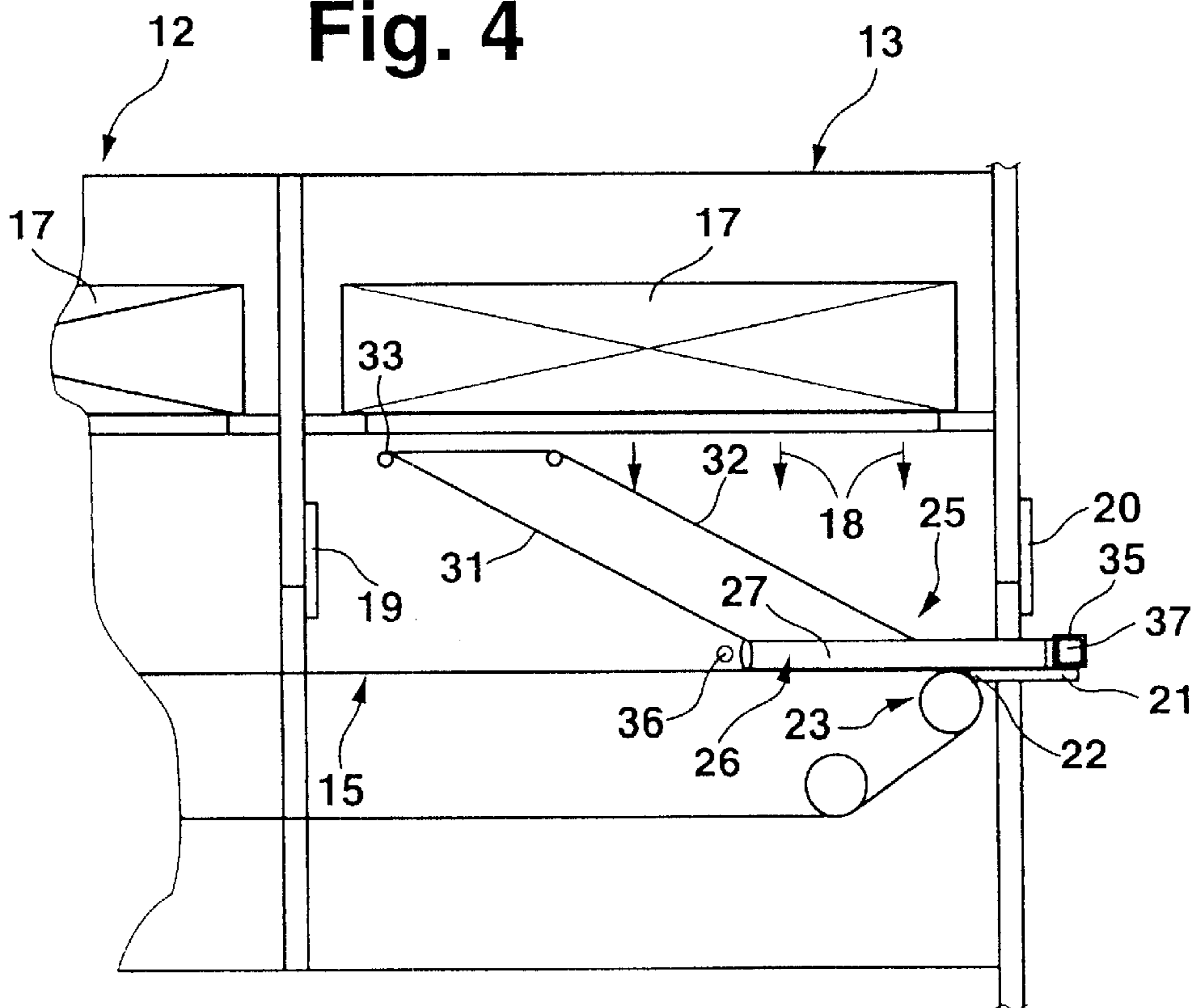


Fig. 4



## STERILIZATION TUNNEL

## PRIOR ART

The invention relates to a sterilization tunnel in which sterilized containers are removed after each batch is run. After the passage of a batch of containers or at the end of a production shift, a sterilization tunnel of this kind must be emptied in order to assure that upon resuming production, packaging containers of a previous batch that could have become contaminated in the meantime are no longer disposed in the sterilization tunnel. To that end, as a rule, at the end of the container flow in the inlet zone of the sterilization tunnel, a bar-shaped emptying slider is placed onto the transport device for the containers, which is embodied as a conveyor belt, and pushes the containers or container parts disposed in front of it through the sterilization tunnel. Of critical importance, however, is the outlet region inside the sterilization tunnel before its outlet chute, at which the containers are transferred from the reversal region of the transport device onto an output plate. At this point, the emptying slider and the containers disposed in front of it come to a stop because the slider is not moved farther by any subsequent element. There are known, expensive mechanical embodiments such as ejection rakes or the like, which must be introduced into the outlet region of the sterilization tunnel from the outside in order to completely eject the emptying slider and the remaining containers. In order to prevent a contamination in outlet regions that can be sterilized, it is therefore often necessary, depending on the type of structural embodiment, to sterilize these parts before introduction into the outlet region.

## ADVANTAGES OF THE INVENTION

The sterilization tunnel according to the invention has the advantage over the prior art that the emptying of the sterilization tunnel can take place manually or automatically in a particularly simple manner. Since no parts have to be introduced into the sterilization or cooling zone of the sterilization tunnel, the result is a particularly simple operation because no parts have to be additionally pre-sterilized.

Other advantages and advantageous improvements of the sterilization tunnel according to the invention ensue from the dependent claims and the description.

## BRIEF DESCRIPTION OF THE DRAWINGS

An exemplary embodiment of the invention is shown in the drawings and will be explained in detail below.

FIG. 1 is a simplified longitudinal section through a sterilization tunnel;

FIG. 2 shows an enlarged sectional view in greater detail of the sterilization tunnel;

FIG. 3 shows a further enlarged sectional view of the sterilization tunnel at another processing stage; and

FIG. 4 shows a further enlarged sectional view of the sterilization tunnel at another processing stage.

## DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

The sterilization tunnel **10** schematically depicted in FIG. 1 is essentially comprised of an inlet zone **11**, a sterilization zone **12**, and a cooling zone **13**. Pharmaceutical containers such as ampules, vials **1**, or the like come from a cleaning machine, are conveyed into the inlet zone **11** of the sterilization tunnel **10**, and leave the tunnel on its opposite end **14**

after the cooling zone **13** in order to be processed further in subsequent filling and closing machines which are not shown.

A horizontally revolving, endless conveyor belt **15** is used to transport the vials **1** through the individual zones inside the sterilization tunnel **10**. In actual use, such conveyor belts are embodied as air-permeable wire mesh belts made of stainless steel. Large filter elements **17** are disposed above the conveyor belt **15** in the different zones of the sterilization tunnel **10** and direct air currents **18**, which are heated by heating devices and produced by ventilators that are not shown, in such a way that the air currents **18**, as so-called laminar flow currents, flow around the vials **1** perpendicular to the transport direction and are then recirculated. Since the air currents **18** have different temperatures in the individual zones, wherein the temperature is the highest in the sterilization zone **12**, vertically adjustable intermediary walls **19** are disposed between the zones in order to reduce or prevent an overflow of the different temperature air between the individual zones.

A transfer plate **21** is disposed in the vicinity of the end **14** of the cooling zone **13**, underneath a likewise vertically adjustable exit chute **20**. The transfer plate **21** protrudes with its one end **22** into the immediate vicinity of the reversal region **23** of the conveyor belt **15** inside the sterilization tunnel **10**. The end of the transfer plate **21** protruding from the sterilization tunnel **10** is adjoined by a transport device, not shown, of the filling and closing machine mentioned above.

An emptying device **25** disposed inside the cooling part **13** of the sterilization tunnel **10** is essential to the invention. The emptying device **25** has a frame **26** that extends in a horizontal plane and is preferably embodied of streamlined profiled rods **27** in order to resist or interrupt the laminar air flow **18** prevailing in the cooling zone **13** as little as possible. In the exemplary embodiment, the profiled rods **27** form a rectangular frame. The frame **26** has four suspension points **28**, **29**, of which the two front suspension points **28** are disposed in the vicinity of the corners on the end of the frame **26** opposite the end **14**. The other two suspension points **29** are disposed approximately in the center of the frame **26**, wherein the center of gravity of the frame **26**, however, is disposed between the suspension points **28**, **29**. Wires **31**, **32** or steel belts are fastened to the suspension points **28**, **29**. The wires **31** associated with the front suspension points **28** are connected to a shaft **33**, which is disposed underneath the filter elements **17** of the cooling zone **13** on the end oriented toward the sterilization zone **12**. The shaft **33** is coupled to a drive mechanism, not shown, which permits the shaft **33** to rotate in both directions. The wires **32** associated with the other suspension points **29** are also connected to the shaft **33**. These wires **32**, however, are conveyed around an axle **34** disposed underneath the filter elements **17** and parallel to the shaft **33**. The lengths of the wires **31**, **32** are matched to one another so that the frame **26** can be lowered or raised in parallel fashion when the shaft **33** is rotated.

The emptying device **25** described above functions as follows: after the last vials **1** of a batch has been supplied to the inlet zone **11** of the sterilization tunnel **10**, or at the end of a production shift, a bar-shaped emptying slider **35** which covers the conveyor belt **15** laterally is placed after the last vials **1**. This emptying slider **35**, together with the last vials **1**, is conveyed by the conveyor belt **15** through the sterilization tunnel **10** (FIG. 2). Preferably, as soon as the emptying slider **35** is disposed at a particular point underneath the frame **26**, which is detected by means of a first sensor **36** coupled to the control unit of the sterilization

tunnel **10**, the lowering of the frame **26** is begun by means of a corresponding rotation of the shaft **33**. In the most favorable instance, the frame **26** lowered onto the conveyor belt **15** comes almost immediately after the emptying slider **35** (FIG. 3).

As soon as the frame **26** has been lowered onto the conveyor belt **15**, the shaft **33** is uncoupled from its drive mechanism or the drive mechanism is switched off so that the frame **26** can be carried along by the conveyor belt **15** without the distance from the emptying slider **35** increasing. Since the frame **26** has a certain mass and since a high static friction factor prevails between the frame **26** and the conveyor belt **15**, which can for example be increased further by means of a coating on the underside of the frame **26**, the leading end of the frame **26** pushes the emptying bar **35**, together with the vials **1** disposed in front of it, over the reversal region **23** of the conveyor belt **15** onto the transfer plate **21** and through the exit chute **20** of the cooling zone **13** (FIG. 4). Since the suspension points **29** are not disposed in the free corners of the frame **26** but approximately in its center, it is possible that the leading end of the frame **26** passes through the exit chute **20** without the exit chute **20** having to be raised because of the wires **32**.

As soon as the emptying bar **35** has been slid through the exit chute **20** by the frame **26**, which can be detected by means of a second sensor **37** coupled to the control unit of the sterilization tunnel **10**, the drive mechanism of the transport belt **15** should be switched off or even operated in the reverse direction in order to facilitate the subsequent return of the frame **26** into its original, raised position. During this returning process, the shaft **33** is now rotated in the opposite direction. As a result, the wires **31, 32** wind onto the shaft **33** and lift the frame **26** from the conveyor belt **15** as soon as the suspension points **28, 29** are disposed beneath the shaft **33** and the axle **34**.

The foregoing relates to a preferred exemplary embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, it latter being defined by the appended claims.

We claim:

1. A sterilization tunnel (**10**), comprising a transport device which supplies pharmaceutical containers, (**1**) through an inlet zone (**11**), a sterilization zone (**12**), and a cooling zone (**13**), which is embodied as an endless conveyor belt (**15**) with a reversal region (**23**) disposed in the cooling zone (**13**), with a transfer element (**21**) adjoins the reversal region (**23**) upon which the pharmaceutical containers (**1**) slide along because of the dynamic pressure of the containers (**1**) subsequently supplied on the conveyor belt (**15**), the transfer element (**21**) passes through the cooling zone (**13**) in the vicinity of a chute (**20**) with an emptying slider (**35**) that covers the conveyor belt (**15**) laterally, the emptying slider can be fed through the zones (**11, 12, 13**) by the conveyor belt (**15**) in order to empty the sterilization tunnel (**10**) and with means for conveying the emptying slider (**35**) further through the chute (**20**), a device (**25**) that can be raised and lowered and used to eject the emptying slider (**35**) from the cooling zone (**13**) is disposed above the conveyor belt (**15**) and for the ejection, the device (**25**) can be lowered onto the conveyor belt (**15**), which brings the device (**25**) into contact with the emptying slider (**35**) and then pushes the slider onto the transfer element (**21**) and through the chute (**20**).

2. The sterilization tunnel according to claim 1, in which the device (**25**) is disposed beneath filter elements (**17**) in an air flow (**18**) directed perpendicular to the feed direction of the containers (**1**) and has a frame (**26**) comprised of rods (**27**).

3. The sterilization tunnel according to claim 2, in which the device (**25**) has suspension points (**28, 29**) for wire elements (**31, 32**) that can be wound and unwound by means of at least one shaft (**33**) coupled to a drive mechanism.

4. The sterilization tunnel according to claim 1, in which the device (**25**) has suspension points (**28, 29**) for wire elements (**31, 32**) that can be wound and unwound by means of at least one shaft (**33**) coupled to a drive mechanism.

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